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PATENT SPECIFICATION

Convention Date (United States of America): July 7, 1942. **566,749**

Application Date (in United Kingdom): July 7, 1943. No. 11013/43.

Complete Specification Accepted: Jan. 11, 1945.

COMPLETE SPECIFICATION

Improvements in and relating to Refrigerating Machines

We, THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED, a British Company having its registered office at Crown House, Aldwych, London, W.C.2, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to refrigerating machines and particularly to such machines which employ evaporators of the so-called secondary type.

It is an object of the invention to provide a refrigerating machine including an improved arrangement for utilising an evaporator of the secondary type.

It is another object of the invention to provide a refrigerating machine including a primary evaporator and a secondary evaporator and an improved arrangement for controlling the operation of the primary evaporator in response to changes in the temperature of the secondary evaporator.

Further objects of the invention will become apparent as the following description proceeds.

The invention consists in a refrigerating machine including a cabinet containing a primary cooling element for cooling an upper portion of said cabinet, a cooling element arranged in heat exchange relationship with the primary element for removing heat from another portion of the cabinet, the secondary element having an evaporating section and a condensing section, and means including a thermal element responsive to the temperature of the primary element for controlling the operation thereof, characterised in that the secondary element has a portion of its condensing section arranged in thermal contact with the thermal element so that a predetermined load demand on the secondary element increases the temperature of the thermal element sufficiently to control the operation of the primary element to satisfy the increase in load demand.

For a better understanding of the invention reference may be had to the accompanying drawings in which Fig. 1 is a view of a portion of a refrigerator cabinet including the cooling compartment and provided with a refrigerating machine embodying the invention; Fig. 2 is an enlarged sectional view on the line 2—2 of Fig. 1; and Fig. 3 is an enlarged sectional view of another view of another portion of the evaporator shown in Fig. 1.

Briefly, the refrigerating apparatus shown on the drawings comprises an insulated refrigerator cabinet provided with an inner metal liner defining a compartment to be cooled and a suitable insulated door for closing the compartment. The compartment is cooled by a primary evaporator of the flooded type arranged in the upper portion thereof, and it is further cooled by a secondary evaporator arranged on the outside of the liner and secured in heat conducting relationship with the liner. Heat from the secondary evaporator is transferred to the primary evaporator by an intermediate evaporator of the secondary type which is removably secured both to the primary evaporator and to the liner in heat exchange with the condenser portion of the secondary evaporator. The primary evaporator is controlled by a temperature responsive device including a thermal element secured to the primary evaporator in the usual manner. A portion of the intermediate evaporator is also secured to the primary evaporator adjacent the thermal element of the control so that upon a sudden load demand on the secondary evaporator system warm vapour will flow to the vicinity of the control element and cause the refrigerating machine to operate the primary evaporator even though the temperature of the primary evaporator is sufficiently low to satisfy the control.

Referring now to the drawing in Fig. 1, we have shown a portion of a domestic refrigerator in which the cooling compartment is located, the base portion in which the machinery compartment is located being omitted as it forms no part of the present invention. The refrigerator comprises a thermally insulated cabinet 10 provided with a metal liner 11 forming a cooling compartment and a door 12 for closing the cooling compartment. In the upper portion of the cooling compartment and suspended from the top wall of the

liner is arranged an evaporator 13. In order to provide additional cooling capacity in the lower portion of the compartment an evaporator 14 of the secondary type is secured to the outside of the liner 11 within the insulated wall of the cabinet. In the form illustrated the evaporator 14 comprises a continuous conduit or duct extending back and forth across the wall of the cooling compartment; the upper portion of the conduit comprises the condensing section of the secondary evaporator; the lower portions comprise the evaporating section. Within the evaporator 14 there is provided a quantity of vaporizable liquid which partially fills the evaporator, the remaining space in the evaporator being filled with vaporised refrigerant. During the operation of the evaporator 14 liquid refrigerant in the evaporating section is vaporised by the absorption of heat; the vapour rises to the condensing section and is condensed and then returns to the evaporating section by gravity. The evaporator 13 is a primary evaporator and is supplied with refrigerant from a suitable refrigerating machine in accordance with the usual practice; this primary evaporator is of the flooded type and includes a liquid and vapour separating header 15 formed by indentations in the sheet metal walls of the evaporator and a plurality of ducts 16 communicating with the lower portion of the header 15 and maintained flooded with liquid refrigerant. The evaporator 13 is operated normally with liquid refrigerant to a level approximately along the centre line of the header 15. Vaporised refrigerant is withdrawn from the header through a suction line 17 in the usual manner by operation of the refrigerating machine, and the periods of operation are determined by a control 18 having an adjusting knob 19. This control starts and stops the refrigerating machine in response to the temperature of the evaporator as determined by a thermal bulb or element 20 clamped to the upper portion of the header 15 above the normal level of liquid refrigerant. The control 18 operates normally to maintain the evaporator 13 at temperatures suitable for the freezing of ice in the space defined by the evaporator walls. A suitable shelf 21, only a portion of which is shown, may be arranged in the evaporator to provide additional freezing surface. In order to operate the secondary evaporator 14 by removing heat therefrom, an auxiliary or intermediate evaporator, also of the secondary type, indicated at 22 is secured in heat exchange relation with the upper or condensing portion of the evaporator 14 and with a side wall of the evaporator 13 adjacent the liquid refrigerant containing ducts. A plurality of clamps 23 are provided on the liner to hold the evaporator 22 tightly against the liner adjacent the evaporator 14 as clearly indicated in Fig. 2 so that heat may readily be transferred through the metal liner from one of the conduits to the other, and a plurality of similar clamps 24 are provided on the side wall of the evaporator 13 to hold the upper or condenser portion of the evaporator 22 in heat exchange relation therewith. The intermediate evaporator 22 thus serves to conduct heat from the secondary evaporator 14 to the primary evaporator 13 without the necessity of having the secondary evaporator 14 extend through the liner 11 into contact with the evaporator 13. Furthermore, by making the intermediate evaporator readily removable the primary evaporator may be taken out for inspection or repair without in any way interfering with the secondary evaporator.

During the operation of the refrigerating machine it may happen that food or other articles placed within the lower portion of the cooling compartment produce a sudden load demand requiring increased capacity of the evaporator 14 and it is desirable that the primary evaporator 13 be maintained in operation even though its temperature may be such that it would not require operation of the refrigerating machine to maintain the primary evaporator within its required range of temperature. There is, therefore, provided an arrangement responsive to the load demand of the secondary evaporator for causing the control 18 to operate and satisfy the load demand of the secondary evaporator even though it is not in operation at the time to satisfy a load demand on the primary evaporator. In the arrangement illustrated and shown in detail in Fig. 3, a vapour riser or conduit 25 is connected in communication with the topmost coil of the intermediate evaporator 22 and extends upwardly into thermal contact with the control element or bulb 20. Whenever there is an increased load demand on the secondary evaporator the refrigerant within the intermediate evaporator 22 which is vaporised rises and increases the temperature within the riser 25. This increase in temperature is immediately felt by the control bulb 20 which responds to start operation or to ensure continued operation of the evaporator 13 to satisfy the demand on the secondary evaporator. The primary evaporator is, therefore, conditioned to operate at a sufficently low temperature to transfer the heat from the secondary evaporator

through the intermediate evaporator to the refrigerating machine as rapidly as possible. The operation of the riser 25 makes the increased load demand immediately effective in modifying the operation of the control without the necessity of increasing the temperature throughout the primary evaporator.

The arrangement described above is particularly useful when the shelves or other obstructions are placed in the cooling compartment so that the lower portion of the compartment or cabinet is not cooled sufficiently by the normal operation of the primary evaporator, in which case the secondary evaporator is relied on to carry a substantial portion of the load. This system will operate to provide adequate capacity of the secondary evaporator even though the food compartment should be divided in two separate compartments by a solid shelf or by the placing of articles on a grille shelf.

It will readily be apparent from the foregoing that we have provided a simple and effective arrangement for transferring heat from a secondary evaporator to the primary evaporator and for ensuring adequate cooling capacity of the secondary evaporator, and that the arrangement makes these advantages possible without the necessity of carrying the secondary evaporator through the metal liner of the cooling compartment.

Having now particularly described and ascertained the nature of our said invention, and in what manner the same is to be performed, we declare that what we claim is:—

1. A refrigerating machine including a cabinet containing a primary cooling element for cooling an upper portion of said cabinet, a cooling element arranged in heat exchange relationship with the primary element for removing heat from another portion of the cabinet, the secondary element having an evaporating section and a condensing section, and means including a thermal element responsive to the temperature of the primary element for controlling the operation thereof, characterised in that the secondary element has a portion of its condensing section arranged in thermal contact with the thermal element so that a predetermined load demand on the secondary element increases the temperature of the thermal element sufficiently to control the operation of the primary element to satisfy the increase in load demand.

2. A refrigerating machine according to claim 1 in which the primary cooling element is of the flooded type having a vapour collecting header at least a portion of which extends above the normal level of liquid refrigerant in the evaporator, and temperature responsive means including a thermal control element secured in heat exchange relationship with the header above the normal level of liquid refrigerant in the primary evaporator for controlling the operation of the primary evaporator, and a riser connects the upper end of the condensing section of the secondary element in thermal contact with the thermal element for actuating the controlling means upon the occurrence of a predetermined increase of load demand on the secondary element to satisfy the increased load demand.

3. A refrigerating machine according to claim 2 including a cabinet provided with a metal liner forming a compartment to be cooled, a primary evaporator for cooling an upper portion of the compartment, a secondary evaporator arranged on the outer wall of the liner in heat conducting relation therewith for cooling a lower portion of the compartment, and an intermediate evaporator of the secondary type for transferring heat from the secondary evaporator to the primary evaporator the intermediate evaporator having a condensing portion removably secured to the primary evaporator, a vapourizing portion removably secured to the liner adjacent the upper portion of the secondary evaporator whereby the intermediate evaporator may be removed from the compartment without disturbing the primary and secondary evaporators and a riser connecting the condensing portion of the intermediate evaporator in thermal contact with the thermal element.

4. A refrigerating machine constructed and operating substantially as hereinbefore described with reference to the accompanying drawings.

Dated this 24th day of June, 1943.

A. S. CACHEMAILLE.
Crown House, Aldwych, London, W.C.2.
Agent for the Applicants.

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FIG. 1.

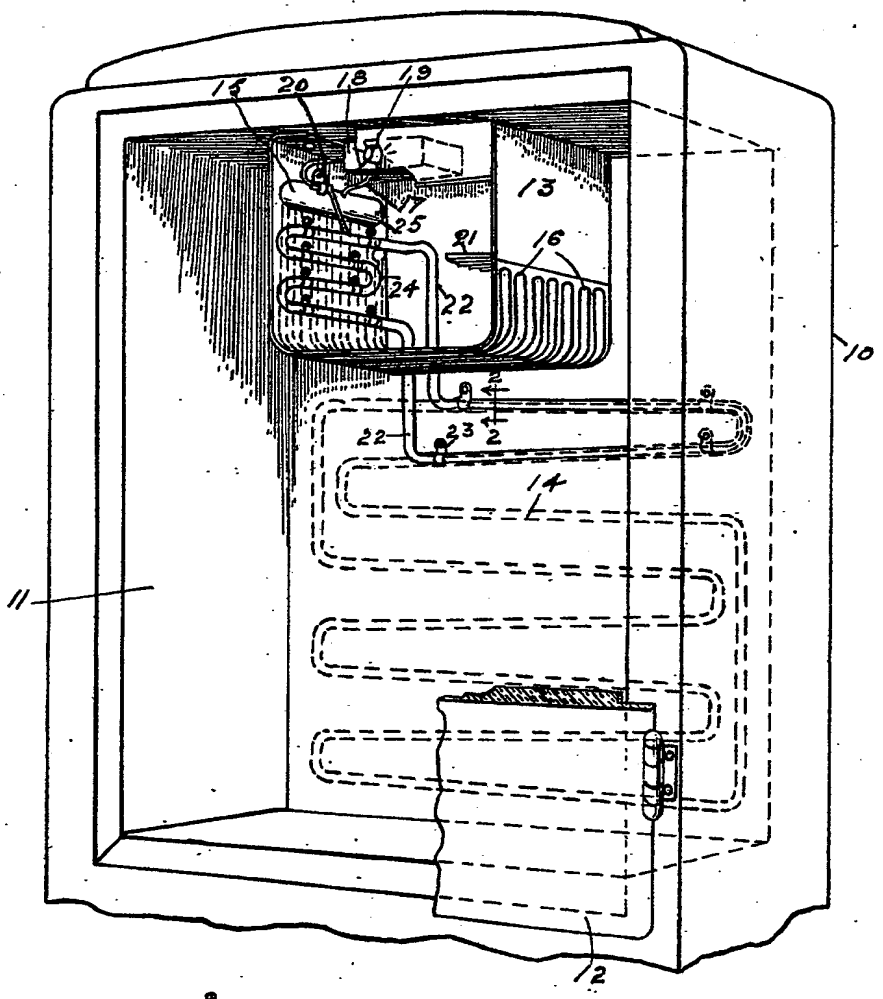


FIG. 3.

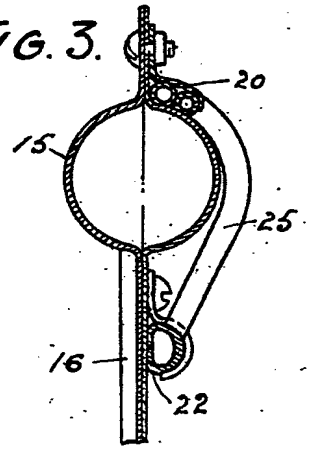
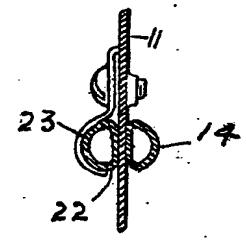


FIG. 2.



[This Drawing is a reproduction of the Original, on a reduced scale.]

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